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FOR

SYSTEM AND METHOD FOR EDGE BLENDING HARD DRIVE HEAD SLIDERS

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SYSTEM AND METHOD FOR EDGE BLENDING HARD DRIVE HEAD SLIDERS

Background Information

[0001] The present invention relates to hard disk drives. More specifically, the invention relates to a system and method for edge blending hard drive head sliders.

[0002] **Figure 1** provides an illustration of a typical hard disk drive. Hard disk drive storage devices typically include a rotating disk 101 mounted for rotation by a spindle motor (not shown). A slider 102, supported by a suspension arm 103, 'flies' over the surface of the magnetic disk 101 at a high velocity, reading data from and writing data to concentric data tracks 104 on the disk 101. The slider 102 is positioned radially by a voice coil motor 105.

[0003] **Figure 2** shows a more detailed view of a head slider 102 flying over the surface of a magnetic disk 101 as is typical in the art. Modern head sliders 102 float over the surface of the disk 101 on a cushion of air. If the 'flying height' is too great, the head 201 on the head slider cannot properly read from and write to the disk 101. If it is too small, there is an increased chance of a head crash.

[0004] If a head slider 102 contacts the surface of the disk while it is at operational speed, the result can be a loss of data, damage to the head slider, damage to the surface of the disk 101, or all three. One of the most common causes of head crashes is a contaminant getting wedged in the microscopic gap between head 102 and disk 101. Head sliders 102 are typically ceramic for durability and corrosion resistance. A ceramic slider is durable due to its hardness. The tradeoff, however, of ceramic's hardness is its brittleness. When a row bar is cut into individual sliders 102 (explained below), the ceramic crystal array causes the slider 102 edges to crack easily. Loose chips of ceramic material may be found on the cutting surface edge corners

even after solvent cleaning. Also, after cutting a row bar into individual sliders, a high point is often left on the cut slider surface. This is known as 'edge jump'. Edge jump is believed to be from the stress applied to the cut edge of the slider 102. A deformation layer 301 is created by the pressure created by the cutting process. (*See* **Figure 3**).

[0005] **Figure 3** illustrates the problems related to particle contamination and edge jump as is typical in the art. The problems concerning loose chips 302 and edge jump 301 can cause hard drive head crashes. A loose chip 302 may fall from the slider and contaminate the interface between the slider 102 and disk 101. An edge jump 301 can affect a slider's anti-shock performance negatively. If the HDD gets a physical impact while operating, a location of edge jump may contact and damage the disk 101.

[0006] It is therefore desirable to have a system and method for edge blending hard drive head sliders.that avoids the above-mentioned problems, as well as having additional benefits.

Brief Description Of The Drawings

[0007] **Figure 1** provides an illustration of a typical hard disk drive.

[0008] **Figure 2** shows a more detailed view of a head slider flying over the surface of a magnetic disk as is typical in the art.

[0009] **Figure 3** illustrates the problems related to particle contamination and edge jump as is typical in the art.

[0010] **Figure 4** illustrates a head parting jig as is typical in the art.

[0011] **Figure 5** illustrates an edge blending jig according to an embodiment of the present invention.

[0012] **Figure 6** illustrates the attachment of a head blending jig to a head blending machine according to an embodiment of the present invention.

[0013] **Figure 7** illustrates portions of lapping tape inserted between individual head sliders mounted to an edge blending jig in a standby configuration and in two edge blending configurations according to an embodiment of the present invention.

[0014] **Figure 8** provides a more detailed illustration of lapping tape partially wrapping a slider's edge to perform edge blending according to an embodiment of the present invention.

[0015] **Figure 9** provides a detailed view of an individual slider mounted to an arm of an edge blending jig with lapping tape partially wrapping a slider edge for edge blending according to an embodiment of the present invention.

[0016] **Figure 10** illustrates an edge blending machine according to an embodiment of the present invention.

Detailed Description

[0017] **Figure 4** illustrates head parting jig as is typical in the art. As is illustrated in figure 4a, a slider row bar 401 is typically bonded to multiple arms 402 of a head parting jig 403. As is illustrated in figure 4b and described further below, the row bar is cut into individual head sliders 102 by a slider parting tool (not shown).

[0018] **Figure 5** illustrates an edge blending jig according to an embodiment of the present invention. As illustrated in **Figure 5a**, in one embodiment, a slider row bar 501 is bonded to multiple arms 502 of the edge blending jig, whereupon the row bar is separated into individual head sliders 102 by a slider parting tool (not shown). One advantage of this jig design is that imperfections on the edges of the sliders 102 (such as edge jump) can be detected by viewing the sliders from behind 505 and observing the uniformity of gaps between the sliders 102.

[0019] **Figure 6** illustrates the attachment of a head blending jig 601 to a head blending machine according to an embodiment of the present invention. In one embodiment, the edge blending jig 601 is coupled to a support assembly 602 of the head blending machine by a pair of pins 603.

[0020] **Figure 7** illustrates portions of lapping tape inserted between individual head sliders mounted to an edge blending jig in a 'standby' configuration and in two edge blending configurations according to an embodiment of the present invention. As illustrated in figure 7a, in one embodiment, lapping tape 701 covered with an abrasive, such as diamond powder (*e.g.*, of a grade between 0.1 microns and 3.0 microns), is inserted between sliders 102. **Figure 7a** shows the edge blending assembly in a 'standby' configuration with the sliders 102 out of contact with the lapping tape 701. **Figure 7b** shows the edge blending assembly configured to partially wrap

the lapping tape 701 across one of the edges of each slider 102 on the edge blending jig 601 according to an embodiment of the present invention. In this embodiment, the lapping tape is positioned by an adjustable series of rollers (described below) to be stretched across the slider edges at a predetermined tension force (*e.g.*, less than 0.8 kilograms). In this embodiment, the edge blending jig 601 is directionally oscillated 702 by the edge blending assembly to cause relative motion between the sliders 102 and the lapping tape 701 (*e.g.*, at a frequency of at least 1 cycle per second and at an amplitude between 10 millimeters and 40 millimeters). **Figure 7c** shows the edge blending assembly configured to partially wrap the lapping tape 701 across the opposite edge of each slider 102 according to an embodiment of the present invention. In this embodiment, the edge blending assembly is configured to stretch the lapping tape 701 across the opposite edge of each slider to complete the edge blending process. As explained below, in one embodiment, the process of edge blending is performed submerged in lubricant.

[0021] **Figure 8** provides a more detailed illustration of lapping tape partially wrapping a slider's edge to perform edge blending according to an embodiment of the present invention. In one embodiment, a first angle (α) is formed between a face 802 of the slider 102 and the lapping tape 801, and a second angle (β) is formed between the opposite face 803 of the slider 102 and the lapping tape 801 (α. and β being between 102 degrees and 90 degrees, for example).

[0022] **Figure 9** provides a detailed view of an individual slider mounted to an arm of an edge blending jig with lapping tape partially wrapping a slider edge for edge blending according to an embodiment of the present invention. In one embodiment, after a row bar is bonded to multiple arms of an edge blending jig 901 (by, *e.g.*, epoxy) and cut into individual mounted sliders 102 (such as by a diamond cutting wheel), lapping tape 902 is inserted between the sliders 102 and the edge blending assembly is configured to wrap the lapping tape 902 around an edge

of the slider 102 under a predetermined amount of tensile force. As stated above, in this embodiment, the slider 102 is directionally oscillated to achieve relative motion between the slider 102 and the lapping tape 902.

[0023] **Figure 10** illustrates an edge blending machine according to an embodiment of the present invention. In one embodiment, an edge blending jig with mounted sliders is coupled to a jig support 1001 and mounted in the edge blending machine. In this embodiment, a top platform 1002, containing lapping tape rollers 1003, is attached to a base unit 1004, supporting the edge blending jig. In this embodiment, portions of lap tape 1005 are positioned and kept in alignment by a series of guide arms 1006. In this embodiment a spring mechanism 1007, which is adjusted by a tension adjustment knob 1008, is utilized to maintain the appropriate tensile force for the portions of lapping tape 1005. Maintaining appropriate lapping tape tension is important to prevent lapping tape 1005 breakage or dislodging of sliders from the edge blending jig arms.

[0024] In this embodiment, another adjustment knob 1009 is utilized to move the lapping tape portions relative to the sliders (on the edge blending jig) to shift the relative position to partially wrap the slider edges appropriately (to provide the appropriate angles of α. and β). In this embodiment, the process of edge blending is performed with the edge blending assembly submerged in lubricant. In this embodiment, a reservoir 1010 is filled above the level of the sliders with a lubricant (such as a mixture of de-ionized (DI) water and oil) before edge blending.

[0025] In one embodiment, rubber tape is used instead of the lapping tape with the reservoir 1010 filled with a diamond slurry. In this embodiment, the diamond particles travel on the rubber tape as an abrasive to smooth the slider edge's surface. Also, in an embodiment, a cleaning process could be performed after edge blending, wherein the lapping tape 1001 is

replaced with rubber tape and the reservoir 1010 is filled with a cleaning solution. The slider would be oscillated with respect to the rubber tape in the cleaning solution to clean any debris left on the sliders after the edge blending process.

[0026] Although several embodiments are specifically illustrated and described herein, it will be appreciated that modifications and variations of the present invention are covered by the above teachings and within the purview of the appended claims without departing from the spirit and intended scope of the invention.